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(54) FUEL CELL SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell system for completely preventing the liquid leakage of fuel and by-products produced in the oxidation of the fuel and the leakage of these to the outside of a fuel cell due to evaporation.

SOLUTION: The fuel cell system comprises an electromotive part having a fuel pole, an oxidant pole and an electrolyte held between the fuel pole and the oxidant pole, a fuel storage container for storing a fuel to be supplied to the fuel pole, a fuel supply part for supplying the fuel from the fuel storage container to the electromotive part, and a fuel discharge part connected to the fuel pole. The fuel storage container, the fuel supply part, the fuel pole and the fuel discharge part are connected together in sealed relation.

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CLAIMS

[Claim(s)]

[Claim 1] The fuel cell system which has the electromotive section possessing the electrolyte membrane pinched between a fuel electrode, an oxidizer pole, and said fuel electrode and said oxidizer pole, the fuel stowage container which contains the fuel supplied to said fuel electrode, and the fuel blowdown section connected to said fuel electrode, and is characterized by for said fuel stowage container, said fuel electrode, and said fuel blowdown section sealing, and connecting them.

[Claim 2] The fuel cell system according to claim 1 characterized by having the product absorption section which absorbs the fuel oxidation product discharged from said fuel electrode.

[Claim 3] The fuel cell system according to claim 2 characterized by said fuel oxidation product containing a carbon dioxide.

[Claim 4] The fuel cell system according to claim 2 characterized by said fuel oxidation product containing the compound which has a carboxylic-acid radical.

[Claim 5] The fuel cell system according to claim 2 characterized by said fuel oxidation product containing the compound which has an aldehyde group.

[Claim 6] The fuel cell system according to claim 2 characterized by said fuel oxidation product containing the compound which has a ketone group.

[Claim 7] The fuel cell system according to claim 2 to which said product absorption section absorbs said fuel oxidation product by physical adsorption.

[Claim 8] The fuel cell system according to claim 2 to which said product absorption section absorbs said fuel oxidation product by chemical absorption.

[Claim 9] The fuel cell system according to claim 3 characterized by having a gas detection means to detect the amount of the carbon dioxide which said product absorption section absorbed.

[Claim 10] The fuel cell system according to claim 2 to 9 characterized by said product absorption section being an exchangeable cartridge-type.

[Claim 11] The fuel cell system according to claim 2 to 10 characterized by said fuel stowage container being an exchangeable cartridge-type.

[Claim 12] The fuel cell system according to claim 2 to 11 characterized by unifying said product absorption section and said fuel stowage container.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the fuel cell system containing the fuel cell using oxygen or air as an oxidizer, using the fuel of a hydrocarbon system as a fuel.

[0002]

[Description of the Prior Art] As a fuel of a fuel cell, the fuel of the liquid of hydrogen gas or a hydrocarbon system or a gas is used, for example. A fuel is reformed in the fuel cell using the fuel of a hydrocarbon system with a refining vessel, hydrogen gas is obtained to it, and there are a type generated using this hydrogen gas as a fuel and a type of them generated using the fuel of the hydrocarbon system supplied directly. It is not necessary to use a refining machine and a fuel cell system can be miniaturized in the latter type.

[0003] About the latter type, the reaction in the fuel cell which uses a methanol is shown below as a hydrocarbon system fuel.

fuel electrode: -- $3/2\text{O}_2 + 6\text{H}^+ + [] - 6\text{e}^- \rightarrow 3\text{H}_2\text{O}$ all cell reaction: -- $\text{CH}_3\text{OH} + 3/2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$:

CH₃OH [0004] + H₂O $\rightarrow \text{CO}_2 + 6\text{H}^+ + 6\text{e}^-$ oxidizer pole As mentioned above, in the fuel cell of the type using a direct fuel, a carbon dioxide generates as a product with a fuel electrode. Therefore, a fuel, a carbon dioxide, etc. which were not consumed are contained in excretions from a fuel electrode. And the internal pressure of a fuel cell rose and there was a problem of causing a liquid spill, cell performance degradation, etc. of a fuel as the amount of the carbon dioxide by such generation of electrical energy increased.

[0005] On the other hand, for example, a carbon dioxide and a fuel are separated from the excretions from a fuel electrode using the porous body which consists of fluororesins, and the fuel cell system equipped with the generation gas blowdown device which discharges only a carbon dioxide besides a system selectively is proposed (for example, patent reference 1 and 2).

[0006]

[Patent reference 1] JP,2001-102070,A [the patent reference 2] U.S. Pat. No. 4,562,123 description [0007] The above-mentioned generation gas blowdown device is explained referring to drawing 5 . Drawing 5 is the outline sectional view showing the structure of a fuel cell of having a generation gas blowdown device. In the fuel cell shown in drawing 5 , the catalyst bed 54 by the side of a fuel electrode and the gaseous diffusion layer 53, and the catalyst bed 56 and the gaseous diffusion layer 57 by the side of an oxidizer pole constitute the electromotive section on both sides of an electrolyte membrane 55, and it has the demarcation membrane 51 which discharges selectively the fuel feeding pipe 52 and carbon dioxide which supply a fuel. The demarcation membrane 51 is formed in contact with the fuel feeding pipe 52 which is the path of the fuel which continues to the gaseous diffusion layer 53, and the carbon dioxide generated in the catalyst bed 54 is discharged out of a fuel cell through this demarcation membrane 51.

[0008] On the other hand, the user of a fuel cell needs to exchange a fuel stowage container, if the residue of a fuel decreases. Therefore, the user of a cell needs to get to know the exchange stage of a fuel stowage container beforehand. It enables it to check the ullage of liquid fuel by looking by the former about this by attaching the methanol consumption sensor which uses infrared radiation, for example, or constituting some fuel stowage containers from transparency or a translucent ingredient.

[0009]

[Problem(s) to be Solved by the Invention] However, the above conventional generation gas blowdown devices cannot separate a carbon dioxide and a fuel selectively thoroughly, but can only separate a gas and a liquid

using the difference of the surface tension of a liquid and a demarcation membrane. Therefore, not only a carbon dioxide but by-products other than a fuel and the carbon dioxide generated in the case of fuel oxidation evaporated, and were discharged out of the fuel cell through the demarcation membrane in the state of gas.

[0010] Thus, many matter which has high toxicity and danger may be contained in the fuel and by-product which are discharged out of a fuel cell. For example, when a methanol is used as a fuel, the methanol which is a fuel, the formic acid with which we are anxious about generation as a by-product in the case of fuel oxidization, formaldehyde, etc. are deleterious substances, and it is a very serious problem that these are revealed out of a fuel cell by evaporation.

[0011] Then, this invention is made in order to solve the above conventional problems, and it aims at preventing thoroughly leakage out of the fuel cell by these evaporation in a fuel cell system as well as a liquid spill of the by-product generated in the case of a fuel and fuel oxidation. This invention aims at offering the fuel cell system which can detect the ullage of a fuel with a sufficient precision by the ability coming [simultaneously], without forming separately the system which detects the ullage of a fuel.

[0012]

[Means for Solving the Problem] It has the electromotive section possessing the electrolyte membrane with which this invention is pinched between a fuel electrode, an oxidizer pole, and said fuel electrode and said oxidizer pole that the above-mentioned technical problem should be solved, the fuel stowage container which contains the fuel supplied to said fuel electrode, and the fuel blowdown section connected to said fuel electrode, and said fuel stowage container, said fuel electrode, and the fuel cell system by which said fuel blowdown section is characterized by to seal and connect offer.

[0013] As for said fuel cell system, it is desirable to have the product absorption section which absorbs the fuel oxidation product further discharged from said fuel electrode. In this case, said fuel oxidation product may contain the carbon dioxide. Moreover, said fuel oxidation product may contain the compound which has a carboxylic-acid radical. Moreover, said fuel oxidation product may contain the compound which has an aldehyde group. Moreover, said fuel oxidation product may contain the compound which has a ketone group.

[0014] In said fuel cell system, it is desirable that said product absorption section absorbs said fuel oxidation product by physical adsorption. Moreover, it is desirable that said product absorption section absorbs said fuel oxidation product by chemical absorption.

[0015] As for said fuel cell system, it is desirable to have a gas detection means to detect the amount of the carbon dioxide which said product absorption section absorbed further. Said fuel cell system is equipped with said product absorption section and/or said fuel stowage container, or they carry out desorption from said fuel cell system, and it is desirable that it is an exchangeable cartridge-type. Therefore, it is desirable even if said product absorption section and said fuel stowage container are unified.

[0016]

[Embodiment of the Invention] An example of the gestalt of operation of this invention is explained to a detail, referring to a drawing. Drawing 1 is the schematic diagram showing the fuel cell structure of a system concerning the gestalt of operation of this invention. In addition, this invention is not limited to this.

[0017] Fuel-feeding-pipe 13a by which the fuel cell system shown in Drawing 1 supplies a fuel to the electromotive section 14 at the sense of an arrow head from the fuel stowage container 11, the electromotive section 14, and the fuel stowage container 11, For example, fuel exhaust pipe 13b which supplies the fuel oxidation product generated in the product absorption section 16 which absorbs the fuel oxidation product generated in the fuel-supply section 12 which consists of a pump, and the electromotive section 14, and the electromotive section 14 to the sense of an arrow head at the product absorption section, The oxidizer supply pipe 18 which supplies an oxidizer to the electromotive section 14 at the sense of an arrow head, and the oxidizer exhaust pipe 19 are provided.

[0018] And fuel exhaust pipe 13b and the product absorption section 16 which constitute the blowdown section by the side of the fuel electrode of the fuel stowage container 11, the fuel-supply section 12, and the electromotive section 14 and a fuel electrode seal, and are connected. The product generated by oxidizing a fuel with the fuel electrode of the electromotive section 14 by this configuration, the fuel which was not consumed can be processed without making it reveal out of fuel electronic system.

[0019] In the fuel cell system shown in Drawing 1, although the fuel-supply section 12 which consists of a pump is formed, even if there is no fuel-supply section 12, the fuel cell system concerning this invention can be

constituted. It is desirable in that case to constitute fuel-feeding-pipe 13a from a capillary which is extent which capillarity commits. Or in order to assist supply of a fuel, the interior of fuel-feeding-pipe 13a may be filled up with a nonwoven fabric or porous bodies, such as polyurethane, polyester, a cellulose, phenol system resin, polypropylene, or a glass fiber.

[0020] The electromotive section 14 consists of cells obtained by pinching an electrolyte membrane on a fuel electrode and the oxidizer pole. Under the present circumstances, the stack obtained by carrying out the laminating of two or more cells may be used, and the cell of the structure which is made to connect two or more cells to a serial and juxtaposition within two or more pages, and is acquired may be used. In addition, a fuel electrode and an oxidizer pole contain a gaseous diffusion layer and a catalyst bed, respectively.

[0021] Here, an example of the configuration of a cell is shown to drawing 2. As shown in drawing 2, the cell consists of 14d of catalyst beds by the side of gaseous diffusion layer 14a by the side of a fuel electrode and catalyst bed 14b, electrolyte membrane 14c, and an oxidizer pole, and gaseous diffusion layer 14e. In drawing 1, fuel-feeding-pipe 13a and fuel exhaust pipe 13b are connected to the fuel electrode side of the electromotive section 14, and the oxidizer supply pipe 18 and oxidizer exhaust pipe 19b are connected to the oxidizer pole side of the electromotive section 14.

[0022] Moreover, although the oxidizer supply pipe 18 which supplies an oxidizer to the electromotive section 14 although not shown in drawing 1 may be mere opening tubing which may be diffused in the electromotive section 14 by using as an oxidizer air inhaled automatically, in order to promote diffusion of air, it may possess compulsory blower styles, such as a fan or a pump.

[0023] In addition, as a fuel of a hydrocarbon system which may be used in the fuel cell system concerning this invention, the ether, such as alcohol, such as a methanol, ethanol, propanol, and ethylene glycol, wood ether, and diethylether, etc. is mentioned, for example.

[0024] Especially the product that checks sealing-ization of a fuel cell system is the big carbon dioxide of cubical expansion among the fuel oxidation products generated when these fuels are used. Furthermore, aldehydes, such as carboxylic acids, such as a formic acid, and formaldehyde, etc. are mentioned as a by-product which is anxious about leakage out of the fuel cell system by evaporation.

[0025] It is desirable to arrange a demarcation membrane 15 between the product absorption sections 16 and fuel-feeding-pipe 13a in drawing 1. As this demarcation membrane 15, only a gas can use a passage, a cone, and the so-called vapor-liquid-separation film that it is hard to pass along a liquid. This demarcation membrane 15 consists of ingredients (ingredient of water and oil repellency) which can give surface tension which is different into the liquid and gas of a fuel. Or the member obtained by covering the front face of a porous body with such an ingredient can also be used. Specifically, the resin of fluorine systems, such as tetrafluoroethylene-hexafluoropropylene copolymer (FEP) resin, can be used.

[0026] An alkaline solid-state or a liquid etc. which absorbs a carbon dioxide by the activated carbon which fixes a carbon dioxide by physical adsorption, the zeolite, or the chemical reaction can be used for the product absorption section 16. As an alkaline solid-state, a hydroxide, carbonates, etc. of alkali metal, such as alkaline earth metal, such as calcium and barium, a potassium, and sodium, are mentioned. Moreover, as an alkaline liquid, diethanolamine, a hydrazine, etc. which are these water solutions and a nonaqueous liquid are mentioned.

[0027] In the product absorption section 16, it becomes possible to prevent leakage of a carbon dioxide and to sealing-ize the whole fuel cell system from the part with which the fuel of the fuel electrode of the fuel stowage container 11, the fuel-supply section 12, fuel-feeding-pipe 13a, and the electromotive section 14, fuel exhaust pipe 13b, and the product absorption section 16 is filled, by fixing the big carbon dioxide of the cubical expansion generated by oxidation reaction of a fuel.

[0028] Thereby, the liquid spill by evaporation out of the fuel cell system of poisonous substances, such as a fuel, a fuel oxidation product, and a by-product, etc. can be lost for the first time. Moreover, even if it uses any of a type which use the type using the above physical adsorption, and chemical absorption as a product absorbent in the product absorption section 16, the carbon dioxide which is a fuel oxidation main product, the formic acid with which we are anxious about leakage by evaporation out of a fuel cell system as a by-product, formaldehyde, etc. can be fixed, and a safe fuel cell system can be realized.

[0029] It is desirable to form the gas detection means for checking the amount of the absorbed product in the product absorption section 16. Since the product absorbent which absorbs a carbon dioxide by the latter

chemical reaction among said product absorbents is matter in which basicity is shown, according to the absorbed amount of a carbon dioxide, pH change produces it by absorbing the carbon dioxide in which acidity is shown. By detecting this pH change, the consumption of a fuel can be known, namely, the residue of a fuel can be grasped.

[0030] It adds beforehand in the product absorbent and the indicator with which color change is accepted as an approach of detecting pH change, for example according to pH change can be checked by viewing. For example, the residue of a fuel can be visually known transparency or by making it translucent for a part of product absorption section 16. Therefore, as for a gas detection means, it is desirable that it is a means to detect the amount of the absorbed carbon dioxide by change of the color of the indicator for example, accompanying pH change.

[0031] In this case, if the fuel stowage container 11 is made into the cartridge-type, since the fuel stowage container 11 is exchangeable for a new thing with residue detection of the fuel by the product absorption section 16, it is effective. Moreover, the product absorption section 16 may also be made into a cartridge-type.

Furthermore, the fuel stowage container 11 and the product absorption section 16 may be unified, and you may make it a cartridge-type. In drawing 1, the fuel stowage container 11 and the product absorption section 16 are unified, and the fuel cartridge 17 is constituted. Only this fuel cartridge 17 can be removed and it can be repeatedly used by exchanging to a new thing.

[0032] In the product absorption section 16, by the indicator which was colorlessness serving as weak base nature or neutrality according to absorption of a carbon dioxide by basicity, and, for example, coloring before an activity, the residue of a fuel can remain, it can come out only, and a certain thing can be known. Remaining fuel can be known with a sufficient precision by making it a design which is filled up with the product absorbent of an amount to the suitable amount of the fuel beforehand paid to the fuel cartridge 17.

[0033] What is necessary is just the indicator which is missing from weak base nature or neutrality from basicity, and causes color change as an indicator added to such a product absorbent. As such an indicator, ethyl violet, a phenolphthalein, alizarin yellow, the cresol phthalein, a thymol blue, alkali blue, etc. are mentioned, for example.

[0034] Moreover, the method of getting to know pH is mentioned by detecting the potential difference as the approach of others which detect pH change using a glass electrode like the so-called pH meter of marketing. By this approach, it can obtain at any time how much residues of a fuel the consumption of a fuel can be known to accuracy, namely, there are from a pH value as an electrical signal. Therefore, a gas detection means may be a pH meter.

[0035] Since the fuel electrode side of the electromotive section 14 is sealed in the fuel cell system concerning this invention, the inside of the product absorption section 16 will always be in the condition of negative pressure by absorbing the fuel oxidation product generated by generation of electrical energy in the product absorption section 16. Therefore, even when there is no fuel-supply section 12 which consists of a pump shown in drawing 1, the absorbed fuel of the volume of gas and this volume will always be supplied to the electromotive section 14 through fuel-feeding-pipe 13a from the fuel stowage container 11.

[0036] Under the present circumstances, since a pressure falls along with reduction in a fuel, it is beforehand filled up with inert gas, such as nitrogen or an argon, by the inside of the fuel stowage container 11, and it should just raise the pressure in the fuel stowage container 11 so that the pressure in the fuel stowage container 11 may not become lower than the pressure in the product absorption section 16, until all fuels are consumed. Thereby, a fuel can be consumed to the last.

[0037] Here, drawing 3 is drawing showing another mode of the part which corresponds near [fuel cartridge 17] drawing 1 . The fuel cartridge 37 shown in drawing 3 possesses the fuel stowage container 31, a demarcation membrane 35, and the product absorption section 36, fuel-feeding-pipe 33a is connected to the fuel stowage container 31, and fuel exhaust pipe 33b is connected to the product absorption section 36 through the demarcation membrane 35. And some walls in the fuel stowage container 31 consist of migration septa 38 which can carry out movable.

[0038] As shown in drawing 3 , it is good also as a migration septum 38 which can move some walls in the fuel stowage container 31. For example, also when moving the migration septum 38 when the pressure in the product absorption section 36 is made negative and a fuel is sucked up from the fuel stowage container 11 by applying a pressure to this migration septum 38 from the exterior, and making it the pressure in the fuel stowage

container 11 not always become negative with a spring or gas pressure, a fuel can be consumed to the last. [0039] Drawing 4 is drawing showing another mode of the part which corresponds near [fuel cartridge 37] drawing 3 . The fuel cartridge 47 shown in drawing 4 possesses the fuel-supply section 42 which consists of the fuel stowage container 41, a demarcation membrane 45, the product absorption section 46, and a pump, fuel-feeding-pipe 43a is connected to the fuel stowage container 41, and fuel exhaust pipe 43b is connected to the product absorption section 46 through the demarcation membrane 45. And some walls in the fuel stowage container 41 consist of migration septa 48 which can carry out movable.

[0040] Moreover, in drawing 4 , the demarcation membrane 45 and the fuel stowage container 41 are connected by tubing 43c. As shown in drawing 4, when the fuel-supply section 42 is formed, the flow of a fuel does not need to adopt the method which is not connected between the product absorption section 46 and the fuel stowage container 41 like [in case there is no fuel-supply section 42]. For example, the structure which prepared tubing 43c is also employable so that the fuel [being unreacted (un-consuming)] separated in the demarcation membrane 45 may return to the fuel stowage container 41 again and may circulate through the inside of a fuel cell system repeatedly.

[0041] In the fuel cell system concerning this invention, a fuel and a product can be treated in a closed space by supplying a fuel to the electromotive section through a fuel feeding pipe from a fuel stowage container, and providing the product absorption section which can absorb the fuel oxidation product which it is consumed by the reaction and generated there. A fuel cell system very safe for a user can be realized without making the fuel and fuel oxidation by-product which have danger and toxicity completely discharge out of a fuel cell system from this.

[0042] Moreover, according to the fuel cell system concerning this invention, the fuel cell system which can supply a fuel to the electromotive section and can generate electricity by being stabilized to the last whose fuel is exhausted in the closed space of this fuel, and being stabilized to the last can also be offered. Moreover, in the fuel cell system concerning this invention, since the consumption of a fuel is detectable in that case, a user can be told with a sufficient precision about the residue of a fuel, and the exchange stage of a fuel cartridge.

Although an example is used for below and this invention is concretely explained to it, this inventions are not these things limited to seeing.

[0043]

[Example] The <<example 1 - 4>> In this example, the fuel cell system which has the structure shown in drawing 1 was produced. The KETCHIEN black EC (the Netherlands country and AKZO Chemie) which is a conductive carbon particle with the first [an average of] particle size of 30nm was made to support a platinum particle with a mean particle diameter of about 30A, and the catalyst support particle by the side of an oxidizer pole (50 % of the weight is platinum) was obtained. Moreover, the KETCHIEN black EC was made to support a platinum particle with a mean particle diameter of about 30A and a ruthenium particle, respectively, and the catalyst support particle by the side of a fuel electrode (25 % of the weight is platinum, and 25 % of the weight is a ruthenium) was obtained.

[0044] Next, the catalyst support particle by the side of an oxidizer pole and a fuel electrode and the dispersion liquid of a hydrogen ion conductivity polyelectrolyte were mixed, respectively, and the catalyst paste by the side of an oxidizer pole and a fuel electrode was prepared. At this time, the mixed weight ratio of a catalyst support particle and a hydrogen ion conductivity polyelectrolyte was set to 1:1. Moreover, as a hydrogen ion conductivity polyelectrolyte, perfluorocarbon sulfonic acid (deflection myon by Asahi Glass Co., Ltd.) was used.

[0045] Subsequently, the catalyst paste by the side of an oxidizer pole was printed to one field of the hydrogen ion conductivity polyelectrolyte film (U.S. Du Pont, Nafion 117), and the catalyst paste by the side of a fuel electrode was printed to it in the field of another side. And the electrolyte membrane electrode zygote (MEA) was created by joining the hydrogen ion conductivity polyelectrolyte film to the gaseous diffusion layer by the side of a fuel electrode, and the gaseous diffusion layer by the side of an oxidizer pole by hot pressing. At this time, catalyst area of a fuel electrode and an oxidizer pole was set to 2cmx2cm. As the gaseous diffusion layer by the side of a fuel, and a gaseous diffusion layer by the side of an oxidizing agent pole, the carbon nonwoven fabric (190 micrometers of thickness, 78% of porosity) was used. Thus, the electromotive section 14 was obtained.

[0046] In the dismountable fuel cartridge 17, the product absorption section 16 containing a product absorbent

was put in, and ten cc of methanol water solutions of 5 % of the weight of methanol concentration was put in in the fuel stowage container 11. Here, (3) soda limes (the 94-% of the weight calcium hydroxide, 6-% of the weight potassium hydroxide) or (4) potassium carbonate water solutions (40 % of the weight of concentration) which absorb a carbon dioxide as a product absorbent by (1) activated carbon (specific-surface-area 600m²/g) which absorbs a carbon dioxide by physical adsorption, (2) zeolites (specific-surface-area 350m²/g), or chemical absorption were used. The amount of the product absorbent used was set to 10g, respectively.

[0047] In addition, the tank was filled up with nitrogen gas and the pressure in a tank was beforehand set as high voltage with 1.3 atmospheric pressures so that the inside of the tank of the fuel stowage container 11 might not become negative pressure by consumption of a fuel. The tetrafluoroethylene-hexafluoropropylene copolymer (FEP) resin film (25 micrometers of thickness, 0.1 micrometers of average apertures) was prepared in the entry of the product absorption section 16 in the fuel cartridge 17 as a demarcation membrane 15 of gas permselectivity. The pump was used as the fuel-supply section 12 for the fuel from the fuel stowage container 11 to the electromotive section 14 to supply. Moreover, compulsive supply of the air by the fan was not performed in the oxidizer supply pipe 18.

[0048] Also when the fuel cell system was operated having used the rate of flow of a pump as 0.5 cc/m and which product absorbent was used, the output of 0.4V and 200mA was obtained. Moreover, in any case, it was stabilized between 0.4-0.45V by the electrical potential difference at the time of a generation of electrical energy till 10 hours, and the output was able to be obtained. Of course, the liquid spill of the gas from a cell was not seen. Furthermore, as air could frequent only the oxidizer pole of the electromotive section 14 freely, from the fuel electrode, fuel-feeding-pipe 13a, fuel exhaust pipe 13b, the fuel stowage container 11, and the product absorption section 16 were altogether put into the Teflon (trademark) bag, and were sealed, and the fuel cell system was operated. The methanol was not detected although the gas in a Teflon bag was analyzed in the gas-chromatograph MATOGU fee after operation termination.

[0049] Therefore, according to the fuel cell system concerning this invention, the safe fuel cell system which it becomes possible to treat a fuel by the sealing system thoroughly for the first time, consequently does not discharge a poisonous fuel, a fuel oxidation by-product, etc. at all out of a system was realizable. Moreover, also when the ingredients which add a barium hydroxide instead of and are obtained, such mixture, and diethanolamine were used in a soda lime as a product absorbent, the almost same effectiveness was acquired. [a calcium hydroxide]

[0050] Example of <<comparison 1>> Except for an example 1 and the following points, the fuel cell system of the same configuration was produced as an example of a comparison. That is, a demarcation membrane 15 is formed in the end of fuel exhaust pipe 13b, by the request, the product absorption section 16 was not formed, but the hole was vacated for the end of fuel exhaust pipe 13b, it opened to atmospheric air, and the gas which came out through the demarcation membrane was made to emit into direct atmospheric air.

[0051] When this fuel cell system was operated by the same service condition as an example 1, the output of 0.40V and 200mA was obtained. Then, between 0.35V-0.40V, it was stabilized till 7 hours and the output was able to be obtained. However, when the glass plate was brought close to the hole of the end of fuel exhaust pipe 13b for several hours, the liquid adhered to this glass plate. Moreover, when this liquid was thinned with pure water and the gas chromatography analyzed it, it turned out that this water solution contains the methanol.

[0052] Moreover, compared with the example 1, the electrical potential difference was a little low, and its actuation time amount was also a little short. Since stagnation of gas was looked at by the demarcation membrane 15 at the time of generation-of-electrical-energy termination, gas had not fallen out from the demarcation membrane 15, the internal pressure near the gas outlet of fuel exhaust pipe 13b increased along with the generation of electrical energy and the excessive load was given to the pump, it was thought that a fuel was no longer supplied fully.

[0053] The <<examples 5-10 and example of comparison 2>> In the fuel cell system which has the completely same configuration as an example 1, the product absorption section 16 and the including [ten cc of methanol water solutions of 5 % of the weight of methanol concentration] fuel stowage container 11 were put in in the dismountable fuel cartridge 17. Here, as a product absorbent, the soda lime (the 94-% of the weight calcium hydroxide, 6-% of the weight potassium hydroxide) or potassium carbonate water solution (40 % of the weight of concentration) of the specified quantity was put in, and ethyl violet was further added as a color coupler. The class and amount of a product absorbent which were used were collectively shown in a table 1. Moreover, the

product absorption section 16 in the fuel cartridge 17 consisted of acrylic resin of transparency.

[0054] Also when the rate of flow of a pump was operated as 0.5 cc/m and which product absorbent was used, the output of generation-of-electrical-energy first stage 0.4V and 200mA was obtained. And after carrying out fixed time amount stability and generating electricity between 0.4-0.45V, the electrical potential difference dived. Moreover, there was a case where it did not regard as the case where coloring (purple from white) of a product absorbent is looked at by 10 minutes when an electrical potential difference dives - 30 quota. The result was collectively shown in a table 1.

[0055] Although operation was possible until it exhausted the fuel mostly when there was a superfluous product absorbent from these results to a fuel, coloring of a product absorbent was not seen to the last. Moreover, although coloring of a product absorbent was seen before the fuel cell system stopped when a product absorbent was insufficient, operation of a fuel cell system stopped, without the ability exhausting a fuel to the last. By pre-using a proper product absorbent to a fuel, when a residue ran short, the exchange stage of the fuel cartridge 17 was able to be known by coloring of a product absorbent.

[0056]

[A table 1]

	生成物吸収部の条件		試験結果	
	生成物吸収剤	使用量(g)	連続運転時間(分)	発色
実施例5	ソーダライム	3	615	有り
実施例6	ソーダライム	5	630	無し
実施例7	ソーダライム	10	645	無し
実施例8	炭酸カリウム水溶液	3	205	有り
実施例9	炭酸カリウム水溶液	5	335	有り
実施例10	炭酸カリウム水溶液	10	625	有り
比較例2	無し	-	420	無し

[0057] Moreover, although the color and product absorbed amount which are discolored, respectively differed from each other as coloring material of a product absorbent when a phenolphthalein, alizarin yellow, the cresol phthalein, a thymol blue, or alkali blue was added besides ethyl violet, discoloration was similarly seen before operation termination of a fuel cell system. Even when these color couplers were used, the exchange stage of the fuel cartridge 17 was able to be known by coloring of a product absorbent by pre-using a proper product absorbent to a fuel.

[0058] Moreover, when pH change in the potassium carbonate water solution as a product absorbent was investigated, although there was pH of a product absorbent then gradually from alkalinity actually, it was changing to the neutrality side. It was detectable in getting to know the consumption of a fuel also by measuring pH of an absorbent from this, i.e., the residue of a fuel.

[0059]

[Effect of the Invention] According to this invention, in a fuel cell system, leakage out of the fuel cell by these evaporation can be thoroughly prevented as well as a liquid spill of the by-product generated in the case of a fuel and fuel oxidation. The fuel cell system which can detect the ullage of a fuel with a sufficient precision can be offered without forming separately the system which can come, simultaneously detects the ullage of a fuel according to this invention.

[Translation done.]